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even confining ourselves to measures made subsequent to Herschel's observation, the discordances from the first assumption are on the whole no larger than those from the second. It would appear from this, therefore, that, as far as can be judged from the observations as yet published, there is not sufficient evidence to justify us in asserting that *p Eridani* is other than a binary star. It is to be hoped that observers in the southern hemisphere will not lose sight of this interesting double star, but will continue to measure it from time to time.

With regard to the proper motions of the components, it appears from a comparison of their places in the Cape Catalogue for 1840 with those in the Cape Catalogue for 1880 that they have a common proper motion of $+0^{s}\cdot03$ in Right Ascension; whilst in North Polar Distance that of the preceding star (the *comes*) is $+0''\cdot07$, and that of the principal star $-0''\cdot08$. These latter values would support the hypothesis of the *comes* moving relatively in a straight line towards the south, but unfortunately the N.P.D. of the following star in the Cape Catalogue for 1840 depends on a single observation, and therefore no reliance can be placed on the proper motion deduced from it.

Blackheath:
1883, *March* 8.

Notes on some of Schjellerup's Identifications of Al-Sufi's Stars.

By J. E. Gore, M.R.I.A.

Some years since M. Schjellerup, the well-known astronomer, published a French translation of two Arabic manuscripts containing a description of the heavens written in the tenth century by the Persian astronomer Al-Sufi. Schjellerup's translation is entitled *Description des Etoiles Fixes, composée au milieu du dixième siècle de notre ère par l'astronome Persan, Abd-al-Rahman Al-Sufi* (St. Pétersbourg, 1874). Schjellerup gives a synopsis of the stars observed by Al-Sufi, identifying Al-Sufi's stars with those at present recognised by Greek and Roman letters, and also giving the magnitude of each star as estimated by Ptolemy, Al-Sufi, and Argelander. I have carefully gone through all Al-Sufi's descriptions of each constellation, comparing his account of the position of each star with the stars as shown in the atlases of Behrmann, Heis and Proctor, and find that in the great majority of cases Schjellerup's identifications are very correct. There are, however, a good many cases in which I cannot agree with Schjellerup with reference to the star described by Al-Sufi. In the Harvard College *Annals*, vol. ix. p. 48, Peirce gives several cases in which he disagrees with Schjellerup, and to these I have added several others. The following are all the cases in which I differ with Schjellerup:—

Hercules.—Two stars mentioned by Al-Sufi amongst the "externes" of this constellation (page 73) as following

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θ *Herculis* are not identified by Schjellerup. They seem to me to be 195, or 199 Heis *Draconis* and κ *Lyræ*. This view seems strengthened by the fact that Al-Sufi in his description of the constellation *Lyra* makes no mention of κ *Lyræ*, so that probably he included it in *Hercules*.

Cassiopeia (page 83).—Peirce is quite right about the 9th star, which is evidently φ, and not θ, as Schjellerup gives. For the 8th star Schjellerup gives μ. I prefer θ, however, as Al-Sufi's description applies equally well to it, and as it is brighter than μ, it was probably the star observed by Al-Sufi. It seems improbable that of two stars close together (like μ and θ) Al-Sufi should have recorded the fainter star and omitted the brighter.

Equuleus (page 111).—In the synopsis Schjellerup does not attempt to identify the 4 stars described by Al-Sufi in this constellation; but from Al-Sufi's description they are evidently: 1=α; 2=β; 3=γ and 4=δ *Equulei*.

Aries, 5th star.—Al-Sufi's description would seem to apply better to 4 Fl than to ι, as Schjellerup gives. Al-Sufi says (p. 125): "La 5^{e} se trouve au sud de la 1re (γ), qu'elle précède vers l'occident, étant située sur le cou." This applies to 4, but not to ι, which *follows* and not *precedes* γ. This identification would, however, imply an error of about 2° in the longitude of Ptolemy's star, so that probably Schjellerup's identification is correct.

Taurus (p. 132). Schjellerup does not identify the stars Nos. 29, 30, 31 and 32 of Al-Sufi, but it is evident from Al-Sufi's description that they are the four brightest stars in the *Pleiades*, 32 being probably η (*Alcyone*). In fact, Al-Sufi says with reference to these stars:—"Il est vrai que les étoiles des *Pleiades* surpassent bien les quatre mentionnées ci-dessus, mais je me borne à ces mêmes quatre, parce qu'elles sont très près l'une de l'autre et les plus grandes; c'est pourquoi nous les avons mentionnées en négligeant les autres."

I agree with Peirce's remarks about star No. 6 of the "externes."

Al-Sufi describes (p. 134) a star to the south of the 11th star (γ *Tauri*) which Schjellerup does not identify. This star seems to be either 79 (*b*) *Tauri* or 83 *Tauri*. I prefer 79, as it is slightly the brighter. Al-Sufi says: "Ces trois étoiles font une ligne parallèle à la ligne boréale de la figure du *dal*" (γ, δ and ε *Tauri*). This applies exactly to σ, ρ and Fl 79.

Virgo, 18th star.—From Al-Sufi's description, this is very evidently Fl 82 (*m*) *Virginis*, and not Lalande 25396, as given by Schjellerup in his synopsis. Al-Sufi says (p. 160): "La 18^{e} suit la 17^{e} [76 Fl]; c'est la plus boréale des deux qui se trouvent dans le côté postérieur du quadrilatère, et forme avec l'obscure 17^{e} et *al-simâk* [*Spica*] une ligne à peu près droite; entre elle et la 17^{e}, il y a un peu plus d'une coudée. Ptolémée la dit des moindres de la quatrième grandeur, mais en vérité elle est des moindres de la cinquième. Avec la 16^{e} [74 Fl] et *el-*

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simâk elle forme un triangle, *al-simâk* étant au sommet ; les deux autres à la base, et la 17^e dans le côté méridional du triangle. Entre la 16^e et la 18^e, il y a moins de deux coudées." All this applies very well to 82 (*m*) *Virginis*, but not at all to Lalande 25396.

Schjellerup identifies the fifth star of the "externes" of *Virgo* with Fl 61 *Virginis*, but it seems to me that the stars 55 and 57 *Virginis* (which are close together) suit Al-Sufi's description better, for he says (p. 161) : "La 5^e est la suivante; c'est une étoile double de la cinquième grandeur." It must be added, however, that this identification is doubtful, as it would imply a large error in latitude in the place of the star as given by Ptolemy.

Scorpio, 14th and 15th stars (p. 172).—Schjellerup does not identify the 15th star, and identifies the 14th with ζ *Scorpii*. From Al-Sufi's description, however, I believe the 15th star to be ζ and the 14th a nebula closely North of ζ, which I have often observed in the Punjab, India, as a hazy star of about magnitude 4½. This nebula is No. 3652 of Sir John Herschel's catalogue of nebulæ in the *Cape Observations*.

Herschel says : "Place of a double star 5 mag., the *p* but one of 7 bright stars in the middle." The positions of Nos. 14 and 15 given by Ptolemy seem to confirm this view, as he makes the stars differ only 10′ in longitude, but the latitudes differ by 50′, No. 14 being the northern of the two ; which agrees with Al-Sufi's description. The stars could not be ζ^1 and ζ^2 *Scorpii*, which have exactly the same Southern Declination.

Schjellerup does not identify No. 1 of the "externes" of *Scorpio*, but it is very evidently the star γ *Telescopii*, which Sir J. Herschel says is in the same field with the nebula 557 *Dunlop*. This nebula is not in Heis' Atlas, but it is marked in Proctor's Atlas, and the star γ *Telescopii* is No. 63 of *Scorpio* in the Catalogue of Behrmann's *Atlas des Südlichen Gestirnten Himmels*, where it is rated 3–4 mag. Lacaille rated it 4 mag. It is No. 7449 of the "Catalogue of 9766 Stars." Al-Sufi says : "Ptolémée la dit nébuleuse."

Sagittarius.—14th star.—Schjellerup says v, but this seems to be a misprint for v.

26th and 27th stars of *Sagittarius.*—Schjellerup identifies these with *m* and *e* of Lacaille. I cannot find what these stars are, but Al-Sufi's 26th star is evidently No. 77 Behrmann *Sagittarius*, and his 27th is ι *Sagittarii* (5–4 mag. Behrmann).

Aquarius (p. 188).—Schjellerup does not identify the 27th and 28th stars, but they seem to be ψ^1 and ψ^2 *Aquarii*. He identifies the 29th star (and I think rightly) with ψ^3 *Aquarii*.

There seems to be something wrong about Al-Sufi's description of the stars 31 and 32 of *Aquarius*. If we assume these stars to be ω^1 and ω^2 *Aquarii*, Al-Sufi's description will not apply, for he says, "La 32^e est la suivante et la plus boréale des deux," whereas, the more northern of the two is *preceding*, not

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following. Possibly Al-Sufi may have observed the variable star R *Aquarii*, when at its maximum, as it lies about the right distance south of ω.

Orion, 6th star.—κ is a misprint for k (74 Fl), which is evidently referred to by Al-Sufi. The 9th star is f_2 (72 Fl), not f_1; and the 10th star is f_1 (69 Fl), not f_2. For Al-Sufi says: "La 9ᵉ est la suivante des deux petites contiguës au nord de la 7ᵉ (ξ) et la 8ᵉ (ν).

30th star (p. 206). Schjellerup makes this v, and Peirce says it is e. I cannot agree with either identification. From Al-Sufi's description the star is c (45) *Orionis*, the northern star in the well-known "sword" of *Orion*. Al-Sufi says: "La 30ᵉ est la boréale des trois étoiles rangées et voisines qui se trouvent au-dessous de la 28ᵉ [ζ *Orionis*], qui est la suivante des trois situées dans la ceinture, s'inclinant de plus d'une coudée vers le sud." This clearly indicates c. Al-Sufi's 37th star is e (29 Fl).

Eridanus, 8th star.—Schjellerup makes this o^2, but Peirce says he prefers 98 Heis *Eridani*. As, however, the latter star is only of the sixth magnitude, I am inclined to agree with Schjellerup that Al-Sufi intended o^2. Ptolemy's star was probably 98 Heis.

34th star.—I agree with Peirce that Al-Sufi's description of the position of this star points to θ *Eridani*, and not to α. Still Al-Sufi says distinctly: "Elle est de la première grandeur; c'est celle que l'on marque sur l'astrolabe méridionale et que l'on nomme *âchir al nahr*, La Fin du Fleuve." However, Peirce is probably right.

17th star of *Eridanus*.—Schjellerup makes this Lalande 4969, but this identification seems doubtful, as Baily says in his notes to Ulugh Beigh's Catalogue: "This star, which is also in Ptolemy's catalogue, cannot now be found."

Canis Major.—I agree with Peirce in his identifications of the stars Nos. 5, 6, 7, 8, 9, without the figure.

Argo, 2nd star (p. 224).—This is called ρ in Proctor's Atlas. Heis calls it ι (15 Fl), and Behrmann ρ, but both these latter authorities agree that the star is B.A.C. 2728.

9th star.—This seems to be Fl 1 *Argûs*; σ is a star about 15° further south.

11th star.—This seems to be B.A.C. 2484 (5 mag. Heis and Behrmann).

13th, 14th, 15th, and 16th stars.—I agree with Peirce in his identifications of these stars.

18th and 19th stars.—I fail to identify these stars from Al-Sufi's description, which does not apply to any stars in the vicinity of ζ, which is Al-Sufi's 17th star. Schjellerup makes the 18th α, which must be a misprint for a. He does not identify the 19th star.

19th star. Al-Sufi in his description of the position of the 33rd star (p. 227) says: "La ligne droit menée de celle-là à la

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brillante 17^e [ζ *Argûs*] passe entre la 18^e et la 19^e, qui sont les deux obscures situées au-dessous de la brillante 17^e." As this remark does not apply to any naked-eye stars in the vicinity of ζ, it would seem possible that Al-Sufi observed two stars which have since disappeared.

The 25th and 26th stars, which Schjellerup does not identify, seem to me to be respectively *a* and *b Velorum* (rated 4–5 by Behrmann). Taking Peirce's identifications of the 23rd and 24th stars as correct (as they seem to be), Al-Sufi's description applies exactly to *a* and *b Velorum*.

With reference to Peirce's remarks about Al-Sufi's stars 28, 29, and 30 of *Argo*, I find that Peirce's stars *a Mali*, *c Mali*, and *d Mali* are identical respectively with o^2, o^3, and o^4 *Navis*, given by Schjellerup; so that Peirce really agrees with Schjellerup.

Hydra, 11th star.—Schjellerup does not identify this star, but from Al-Sufi's description (p. 233) it seems to be 58 Heis *Hydræ* (=3226 B.A.C.). Al-Sufi says: "La 11^e est une petite étoile des moindres de la sixième grandeur; Ptolémée la dit absolument de la sixième. Elle se trouve dans le voisinage et du côté boréal de la brillante [α *Hydræ*] située entre celle-ci et la 10^e [τ' *Hydræ*]."

9th star.—Schjellerup makes this α *Centauri*, but this is evidently a mistake. From Al-Sufi's description the 9th star is plainly 165 Behrmann *Centaurus* (=4759 B.A.C. = 5911 Lacaille).

10th and 11th stars.—Schjellerup calls these *c* and *b Centauri*. They seem to be respectively 175 and 173 Behrmann (5–4 mag.).

19th star.—Schjellerup identifies this with *o*, and does not attempt to identify the 20th star. From Al-Sufi's description the stars 18, 19, and 20 are probably :—18 = ζ (as Schjellerup gives), 19 = v^2 *Centauri*, and 20 = v^1 *Centauri*. The magnitudes given by Behrmann for these stars agree well with those of Al-Sufi.

21st star.—Schjellerup does not identify this; but from Al-Sufi's description of the position of this and the 22nd star (ξ) there can, I think, be very little doubt that the object referred to by Al-Sufi is the well-known cluster ω *Centauri*. Al-Sufi's words are: "La 21^e se trouve devant la brillante 18^e [ζ], et est de la cinquième grandeur" [I have seen it in the Punjab like a hazy star of about 4½ mag.]; "elle est située où commence la croupe du cheval et finit le dos humain. Il y a entre elle et la 18^e une distance de deux coudées et demie." This exactly describes the position of ω.

28th star of *Centaurus*.—Schjellerup does not identify this, but it seems to be Behrmann's 125 *Centauri* (5–6 mag.) (= 4580 B.A.C.). Al-Sufi's description applies to this star very fairly.

37th star.—Schjellerup makes this θ *Centauri*, but this is apparently a misprint. The star referred to by Al-Sufi is—according to his very clear description—the star marked *o* in Behrmann's

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Atlas. It is No. 84 (*Centaurus*) in the Catalogue, where it is rated 4·5 mag., but has no letter attached to it. Al-Sufi's magnitude is also 4·5. Al-Sufi's 6th star is θ.

Lupus.—With reference to two stars described by Al-Sufi (p. 246) south of α *Lupi*, and which Al-Sufi says are not mentioned by Ptolemy, Schjellerup remarks in a foot-note, "Probablement α_2 and α_1." I cannot find what stars α_1 and α_2 are, but the stars referred to by Al-Sufi are very evidently ρ and σ *Lupi*, rated 5 mag. by Behrmann.

16th and 17th stars.—Schjellerup makes the 16th star λ; but as λ is the 6th star, this cannot be λ. He does not identify the 17th. From what Al-Sufi says, the 16th and 17th stars are very evidently χ and ξ *Lupi* (5–6 mag. Behrmann).

18th and 19th stars.—Schjellerup makes the 18th δ *Lupi*; but δ is the 3rd star. He does not identify the 19th. These stars seem to be 1 and 2 *Lupi* in Proctor's Atlas (30 and 33 Behrmann, *Lupus*).

Corona Australis, 7th star.—Schjellerup makes this κ; but this is evidently wrong. The star is clearly α, for Al-Sufi says, "La 7^{e} se trouve au-dessus et près de la 6^{e} [β] vers le nord."

10th star.—This Schjellerup does not identify, but it is probably 20 Behrmann (= 6444 B.A.C.).

13th star.—Schjellerup calls this ξ; but in Behrmann's Southern Atlas there is no star which exactly suits Al-Sufi's description, the nearest being Behrmann's No. 8. But this is only 1° south of κ, instead of $3° \; 30'$ ("une coudée et demie") as stated by Al-Sufi.

I will conclude with a remark made by Peirce (Harvard *Annals*, vol. ix. p. 51), and which I fully endorse:—"The work which the learning of M. Schjellerup has brought to light is so important that the smallest errors of details become interesting."

The Variability of β Cygni and 63 Cygni.

By the Rev. T. E. Espin, B.A.

It has doubtless escaped Professor Pritchard that the star β *Cygni* has long been suspected of variation. It will be found entered as a suspected variable in *Chambers' Astronomy*, where the authority for its variation is Klein, and in the catalogue of 343 suspected variable stars published in the *English Mechanic* (communication No. III., June 21, 1882), where the authorities are Klein and Webb. A letter of the Rev. Prebendary Webb in the same periodical calls attention to the loss of light of late in this star. β *Cygni* belongs to a class of variable stars which seem quite distinct from the ordinary variables of Class I. and Class II. (*i.e.* stars with periods of less than 80 days and slight variation, and stars with periods above 130 days and great variation). The variation of β *Cygni* is not large—probably less than a magnitude—while the period is one of several years.